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(56) Documents cited GB 1513898 GB 1058300 GB 1031975 GB 760321
(58) Field of search G1A G2J
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(54) **Two-dimensional measuring apparatus**

(57) Two dimensional measuring apparatus includes a surface 15 on which an object to be measured can be placed and under which is an optical grating 16 comprising two sets of parallel lines perpendicular to axes at a known angle to each other, usually 90°. A base 10 movable relative to surface 15 in a plane containing the directions of the axes carries probe 18 and support 19, bearing two reading heads 21, 22 each having a source, detector and an index grating with lines 23 or 24 co-operating with grating 16 to derive electrical signals indicative of movement of an index point, which is in the plane of lines 23, 24 and on the axis of probe 18. Support 13 is moveable relative to rails 11 on base 10, by wheels 12 and by sliding along their axles.

Fig.1.

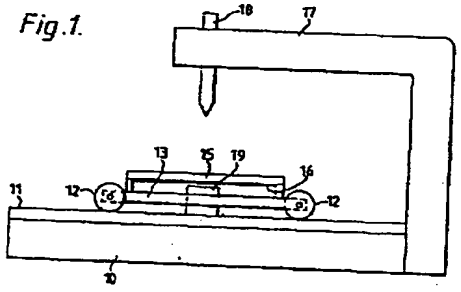
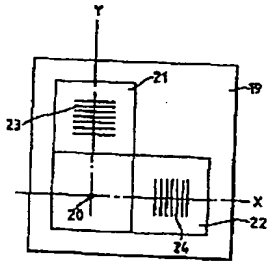


Fig.3.



The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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Fig.1.

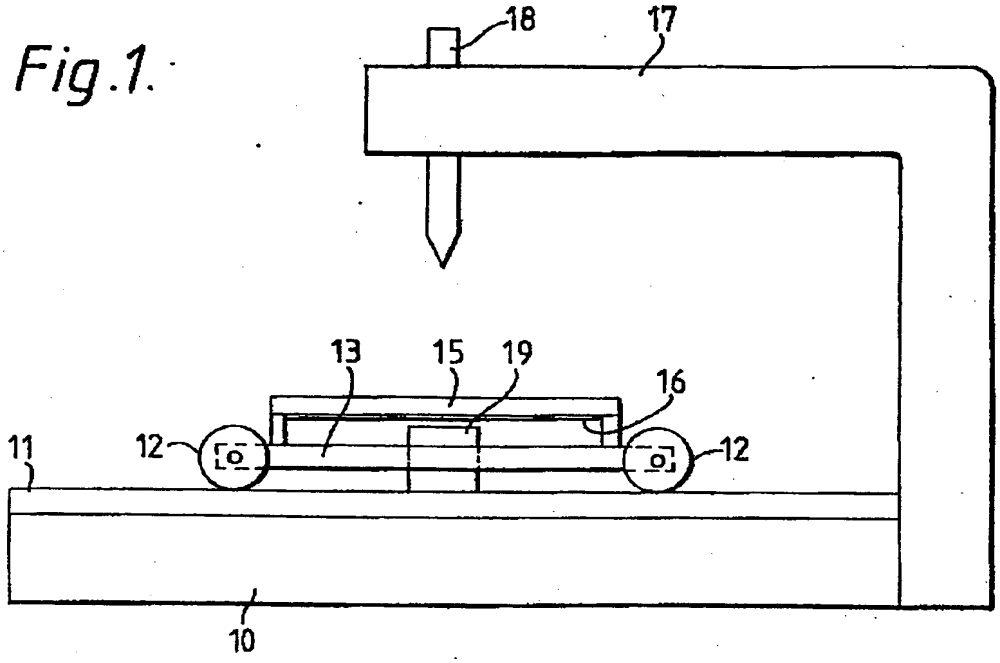
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Fig.2.

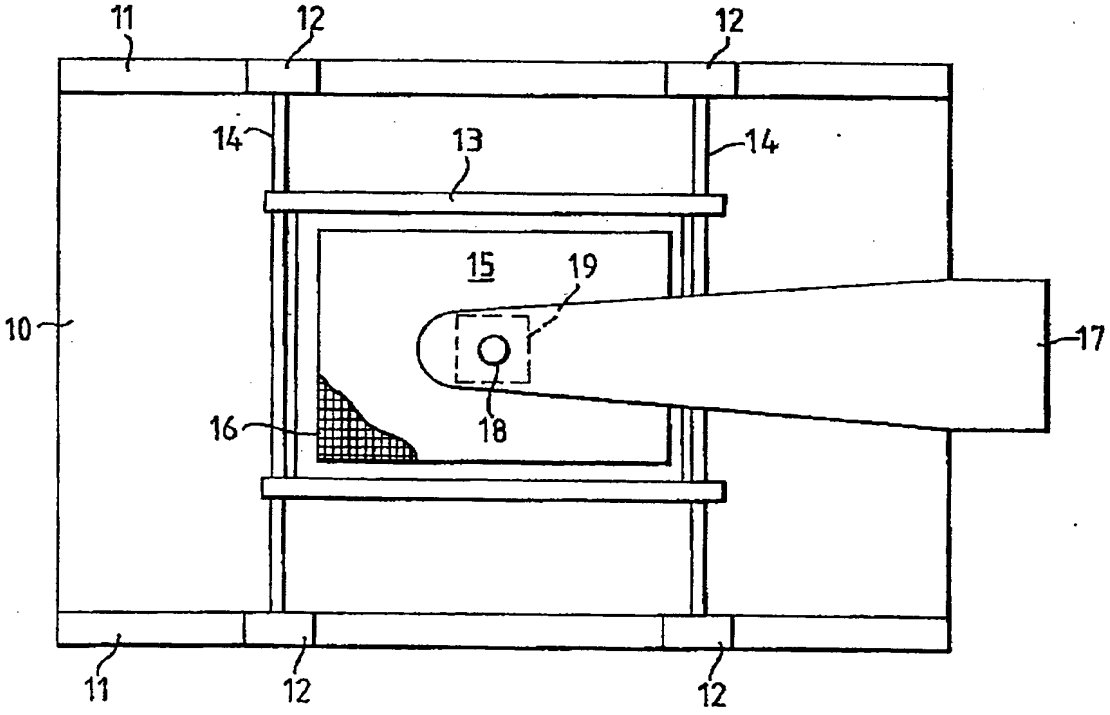
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Fig.3.

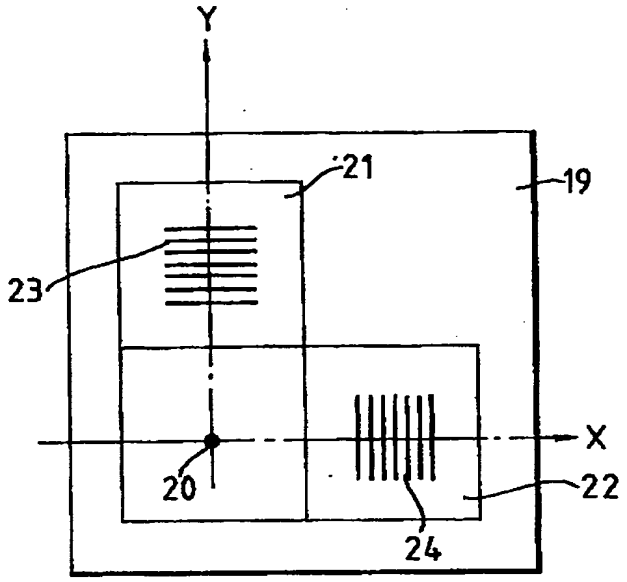
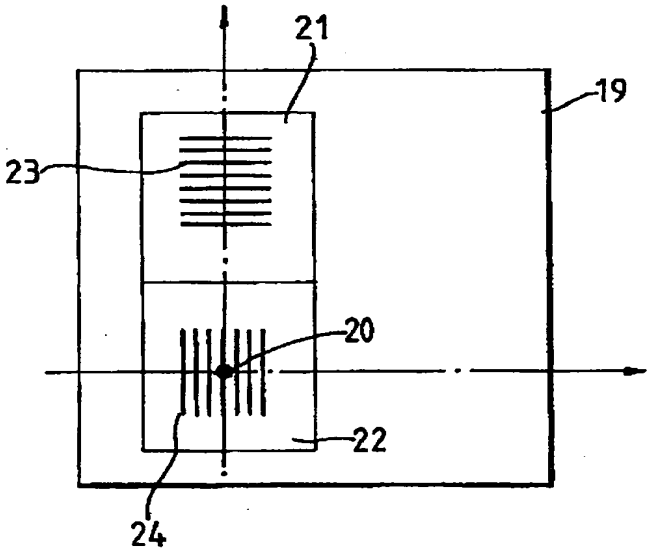


Fig.4.



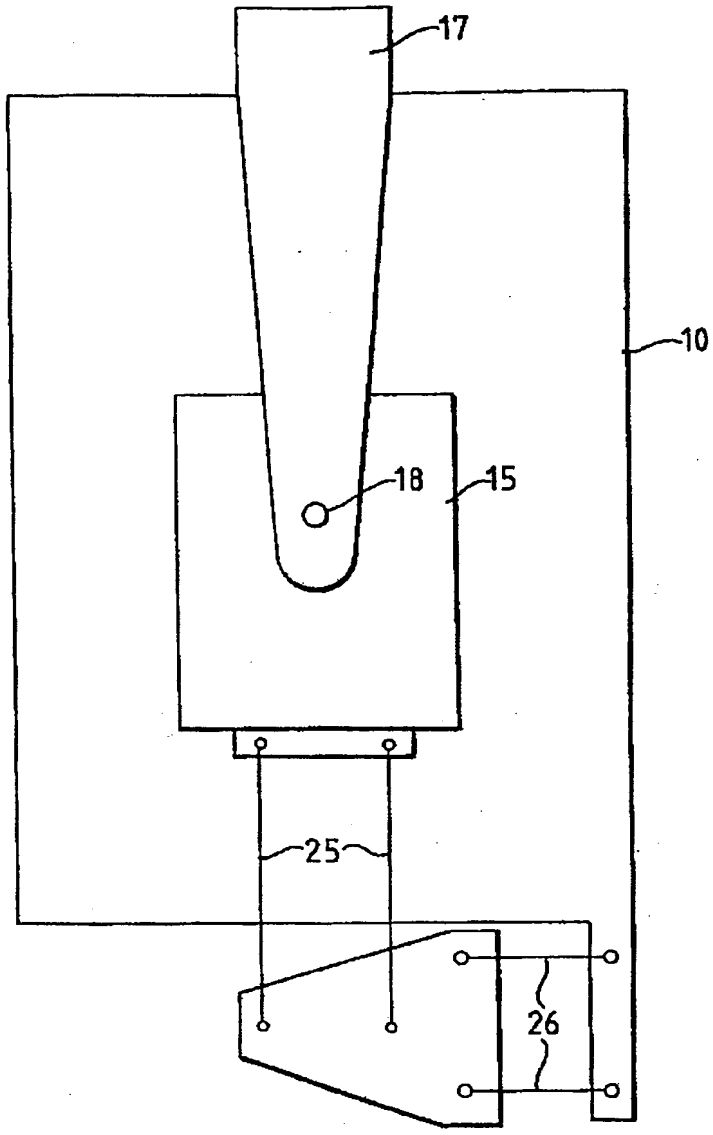


Fig .5.

SPECIFICATION

Measuring apparatus

This invention relates to measuring apparatus, and in particular to apparatus for performing linear measurement in two dimensions.

Many types of apparatus exist for linear measurement in two dimensions, through many of these are complex and expensive pieces of apparatus intended for three-dimensional measurement. There is a requirement for a low-cost but accurate measuring apparatus for two-dimensional measurement, and it is an object of the present invention to provide such apparatus.

According to the present invention there is provided measuring apparatus which includes a surface upon which may be placed an object to be measured; and optical grating extending over the usable area of the surface, the grating comprising two sets of closely-ruled parallel lines extending perpendicular to two axes at a known angle to one another; a support member movable relative to the surface in a plane containing the two axes and carrying a probe member positioned above the surface; and first and second reading heads carried by the support member and each comprising an index grating, a light source and a light-sensitive detector together arranged to co-operate with the optical grating so as to derive electrical signals indicative of movements of an index point, located in the plane of the index gratings and on the axis of the probe member, relative to the surface in a direction parallel to one or other of the two axes, the index grating of the first reading head bearing a set of closely-ruled parallel lines aligned substantially normal to one of the axes and centred about that axis, the index grating of the second reading head bearing a set of closely-ruled parallel lines aligned substantially normal to the other axis and centred about that other axis.

Preferably the two axes are perpendicular to one another.

Normally the optical grating will be located under the surface to prevent part of the grating being obscured by the object to be measured. The optical grating may be of either the reflecting or transmitting type, though the use of a reflecting grating leads to a simpler mechanical arrangement.

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a schematic side view of one form of measuring apparatus;

Figure 2 is a plan view of the apparatus of Figure 1;

Figures 3 and 4 are enlarged plan views of alternative reading heads of Figures 1 and 2; and

Figure 5 is a plan view of a second form of measuring apparatus.

Referring now to Figures 1 and 2, a base 10 is provided with guide rails 11 along which run the wheels 12 of a carriage 13. The carriage 13 is able to slide sideways on the axles 14 joining opposite pairs of wheels 12. On the carriage is a surface 15 on which an object to be measured may be placed. The underside of the surface 14 carries a cross-ruled reflecting grating 16, part of which is shown in Figure 2. The grating is of the same dimensions as the usable area of the surface 15 and comprises two sets of closely-ruled parallel lines, the two sets of lines being at right angles to one another. Supported above the base 10 on a rigid supporting arm 17 is a probe 18, and secured to the base 10 under the carriage is a plinth 19 carrying two reading heads. The axis of the probe 18 defines and index point located in the plane of the reading heads.

As shown in Figures 1 and 2 the carriage 13 is movable along one axis on the guide rails 11, and is also movable on the axles 14 along a perpendicular axis. The means for moving and aligning the carriage are not shown in detail, and many alternative arrangements are possible.

Figure 3 shows an enlarged plan view of the plinth 19 of Figures 1 and 2. As already stated the plinth 19 carries two reading heads 21 and 22. Reading head 21 is that used to detect movements of the carriage parallel to the Y-axis, and includes a grating having closely-ruled parallel lines 23 of the same pitch as those of cross-ruled grating 16. The lines 23 extend normal to the Y-axis and are centred about the Y-axis. The other reading head 22, which is that used to detect movements of the carriage parallel to X-axis has a grating with closely-ruled parallel lines 24 of the same pitch as the cross-ruled grating 16. The lines 24 extend normal to the X-axis and centred about the X-axis. Each reading head will also include a light source and light-sensitive detectors. Such reading heads are of the type commonly used with two-grating measuring systems and are not described in detail. Similarly the electrical circuitry necessary to respond to the outputs of the reading heads are well known. With the lines 23 and 24 of the same pitch as those of cross-ruled grating 16 the two reading head gratings must be skewed slightly to produce the necessary Moire fringe effects. The two sets of gratings may alternatively have their lines parallel but of slight different pitch, or may carry lines each of which are stepped by a quarter of a pitch.

The probe 18 should preferably be adjustable in a vertical direction so that it may be placed close to the surface of the object being measured. It may be in the form of an optical sighting device with cross-wires. Either one of the reading heads may be located so that the notional index mark is within the area of the reading head, as shown in Figure 4.

With the reading heads located as defined above with respect to the index mark, the errors due to misalignment of the carriage by rotation about a vertical axis are reduced to a minimum.

Figure 5 illustrates an alternative embodiment of the invention in which the surface 15 is movable over the base 10 and its alignment is maintained by means of a pantograph having two sets of parallel linkages 25 and 26. One pair of

linkages 25 is attached at one end to the surface 15 whilst the other pair 26 is attached to the base 10.

In place of the fixed probe and reading heads, and movable surface, as described above, the surface could be fixed in position. A suitable rigid framework may then be used to carry the probe and the reading heads, and arranged to move so as to maintain the alignment between the reading head gratings and the cross-ruled grating.

CLAIMS

1. Measuring apparatus which includes a surface upon which may be placed an object to be measured; and optical grating extending over the usable area of the surface, the grating comprising two sets of closely-ruled parallel lines extending perpendicular to two axes at a known angle to one another; a support member movable relative to the surface in a plane containing the two axes and carrying a probe member positioned above the surface; and first and second reading heads carried by the support member and each comprising an index grating, a light source and a light-sensitive detector together arranged to co-operate with the optical grating so as to derive electrical signals indicative of movements of an index point, located in the plane of the index gratings and on the axis of the relative to the surface in a direction parallel to one or other of the two axes, the index grating of the first reading head bearing a set of closely ruled parallel lines aligned substantially normal to one of the axes and centred about tht axis, the index grating of the second reading head bearing a set of closely-ruled parallel lines aligned substantially normal to the other axis and centred about that other axis.

2. Measuring apparatus as claimed in Claim 1 in which the two axes are perpendicular to one another.

3. Measuring apparatus as claimed in either of Claims 1 or 2 in which the optical grating comprises a reflecting grating located under the surface.

4. Measuring apparatus as claimed in any one of Claims 1 to 3 which includes a base supporting the probe member and the reading heads, and a carriage movable over the surface in directions parallel to said two axes.

5. Measuring apparatus as claimed in any one of Claims 1 to 4 which includes a pantograph having two pairs of parallel linkages connecting the surface to the base to maintain the alignment of the reading heads.

6. Measuring apparatus substantially as herein described with reference to the accompanying drawings.

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